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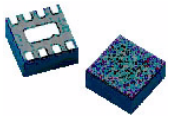
Preliminary

SPF-5122Z

50MHz to 4000MHz, GaAs pHEMT LOW NOISE MMIC AMPLIFIER

RoHS Compliant and Pb-Free Product

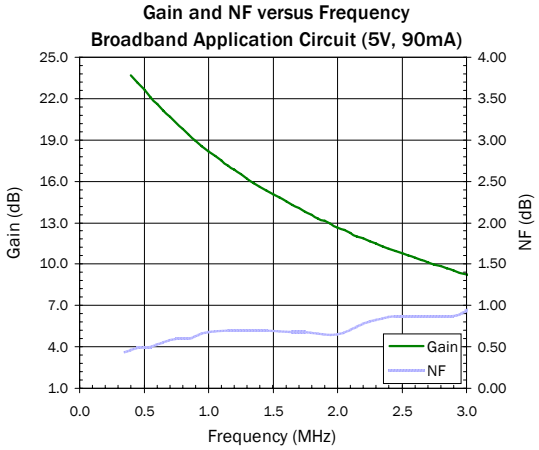


Product Description

The SPF-5122Z is a high performance pHEMT MMIC LNA designed for operation from 50MHz to 4000MHz. The on-chip active bias network provides stable current over temperature and process threshold voltage variations. The SPF-5122Z offers ultra-low noise figure and high linearity performance in a gain block configuration. Its single-supply operation and integrated matching networks make implementation remarkably simple. A high maximum input power specification make it ideal for high dynamic range receivers.

Optimum Technology Matching® Applied

- ☐ GaAs HBT
- ☐ GaAs MESFET
- ☐ InGaP HBT
- ☐ SiGe BiCMOS
- ☐ Si BiCMOS
- ☐ SiGe HBT
- ☑ GaAs pHEMT
- ☐ Si CMOS
- ☐ Si BJT
- ☐ GaN HEMT
- ☐ RF MEMS



Features

- Ultra-Low Noise Figure=0.60dB @ 900MHz
- Gain=18.9dB @ 900MHz
- High Linearity: OIP3=40.5dBm @ 1900MHz
- Channel Power=13.4dBm (-65dBc IS95 ACPR, 880MHz)
- P_{1dB}=23.4dBm @ 1900MHz
- Single-Supply Operation: 5V @ Idq=90mA
- Flexible Biasing Options: 3-5V, Adjustable Current
- Broadband Internal Matching

Applications

- Cellular, PCS, W-CDMA, ISM, WiMAX Receivers
- PA Driver Amplifier
- Low Noise, High Linearity Gain Block Applications

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Small Signal Power Gain		18.9		dB	0.9GHz
		12.9		dB	1.96GHz
Output Power at 1dB Compression		23.0		dBm	0.9GHz
		23.4		dBm	1.9GHz
Output Third Order Intercept Point		37.9		dBm	0.9GHz
		40.5		dBm	1.9GHz
Noise Figure		0.59		dB	0.9GHz
		0.64		dB	1.9GHz
Input Return Loss		-14.6		dB	0.9 GHz
		-21.0		dB	1.9GHz
Output Return Loss		-16.8		dB	0.9GHz
		-13.0		dB	1.9GHz
Reverse Isolation		-24.1		dB	0.9GHz
		-18.4		dB	1.9GHz
Device Operating Voltage		5.00	5.25	V	
Device Operating Current		90		mA	Quiescent
Thermal Resistance		65		°C/W	Junction to lead

Test Conditions: V_D=5V, I_{DQ}=90mA, OIP_3 Tone Spacing=1MHz, P_{OUT} per tone=0dBm
Z_S=Z_L=50Ω, 25°C, Broadband Application Circuit

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Absolute Maximum Ratings

Parameter	Rating	Unit
Max Device Current (I_D)	120	mA
Max Device Voltage (V_D)	5.5	V
Max RF Input Power	27	dBm
Max Dissipated Power	660	mW
Max Junction Temperature (T_J)	150	°C
Operating Temperature Range (T_L)	-40 to + 85	°C
Max Storage Temperature	-65 to +150	°C
ESD Rating - Human Body Model (HBM)	Class 1B	
Moisture Sensitivity Level (MSL)	MSL 1	

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.

Bias Conditions should also satisfy the following expression:
$I_D V_D < (T_J - T_L)/R_{TH}$, j-l and $T_L = T_{LEAD}$

Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).

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Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=90mA

Parameter	Unit	0.1 GHz*	0.4 GHz	0.9 GHz	1.5 GHz	1.9 GHz	2.2 GHz	2.5 GHz	3.5 GHz	3.8 GHz
Small Signal Gain	dB	27.0	24.0	19.0	15.0	13.0	12.0	11.0	6.0	7.0
Noise Figure	dB	0.42	0.47	0.59	0.70	0.64	0.73	0.86	1.35	1.27
Output IP3	dBm	33.0	36.0	38.0	39.5	40.5	41.0	41.5	40.5	41.5
Output P1dB	dBm	22.3	22.7	23.0	23.2	23.4	23.7	23.9	22.2	22.9
Input Return Loss	dB	-9.5	-10.0	-14.5	-20.0	-21.0	-22.0	-22.5	-15.0	-11.5
Output Return Loss	dB	-29.0	-19.5	-17.0	-14.0	-13.0	-12.5	-12.5	-7.5	-15.5
Reverse Isolation	dB	-32.0	-29.0	-24.0	-20.0	-18.5	-17.5	-16.5	-15.5	-13.5

Test Conditions: V_D=5V, I_{DQ}=90mA, OIP_3 Tone Spacing=1MHz, P_{OUT} per tone=0dBm, T_L=25°C, Z_S=Z_L=50Ω, *Bias Tee Data @ 100MHz

1. Input RL can be improved in the 800MHz to 1000MHz band by adding a series inductor between the DC block and device input.

Typical RF Performance - Broadband Application Circuit with V_D=3V, I_D=58mA

Parameter	Unit	0.1 GHz*	0.4 GHz	0.9 GHz	1.5 GHz	1.9 GHz	2.2 GHz	2.5 GHz	3.5 GHz	3.8 GHz
Small Signal Gain	dB	26.0	23.0	18.5	14.5	12.5	11.5	10.5	6.0	6.5
Noise Figure	dB	0.35	0.44	0.58	0.65	0.61	0.69	0.79	1.25	1.19
Output IP3	dBm	31.5	33.0	34.5	36.0	36.5	37.0	37.5	37.0	37.5
Output P1dB	dBm	18.8	18.9	19.1	19.4	19.9	20.2	20.1	18.9	19.2
Input Return Loss	dB	-8.0	-9.0	-13.0	-16.5	-18.5	-19.0	-19.0	-13.5	-10.0
Output Return Loss	dB	-26.0	-28.5	-23.5	-18.0	-16.5	-16.0	-15.5	-9.0	-14.0
Reverse Isolation	dB	-31.0	-28.0	-23.0	-19.0	-17.5	-16.0	-15.0	-14.5	-12.5

Test Conditions: V_D=3V, I_{DQ}=58mA, OIP_3 Tone Spacing=1MHz, P_{OUT} per tone=0dBm, T_L=25°C, Z_S=Z_L=50Ω, *Bias Tee Data @ 100MHz

1. Input RL can be improved in the 800MHz to 1000MHz band by adding a series inductor between the DC block and device input.

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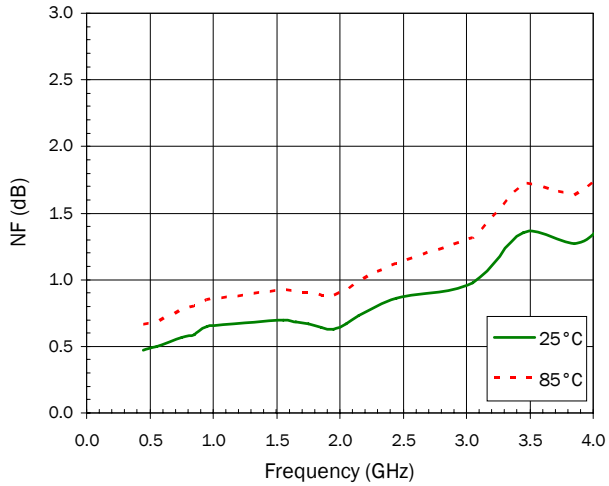
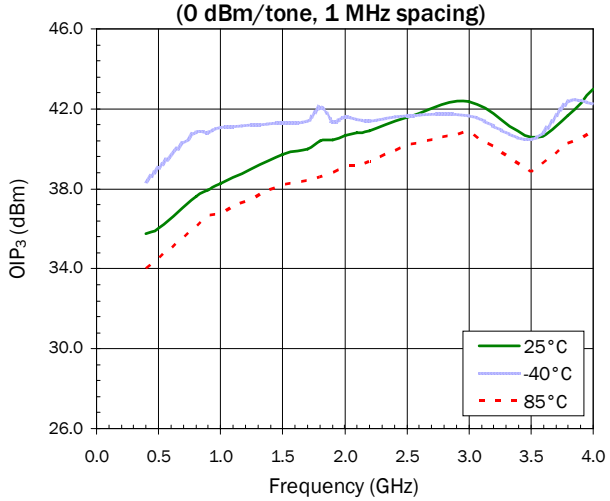
Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=90mA

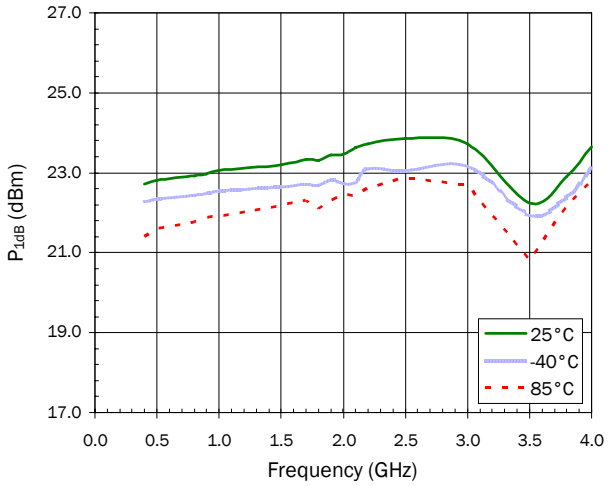
NF versus Frequency



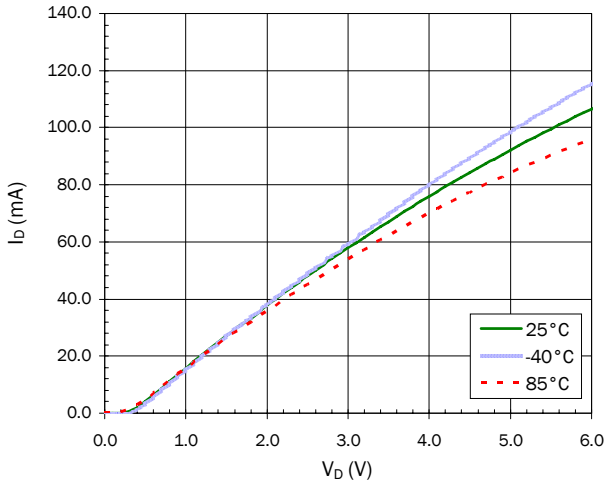
OIP_3 versus Frequency
(0 dBm/tone, 1 MHz spacing)



P_{1dB} versus Frequency

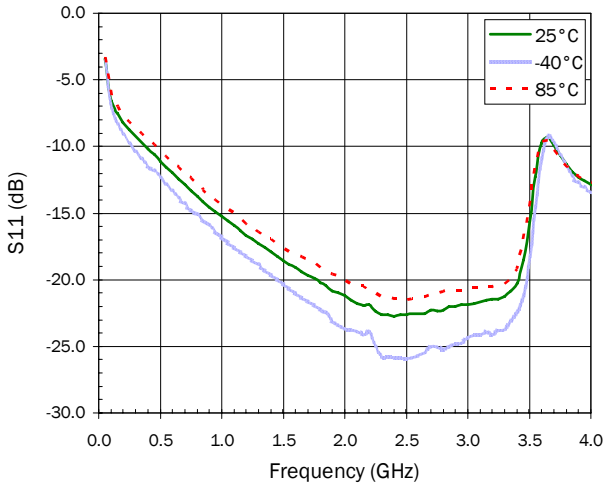


Device Current versus Voltage

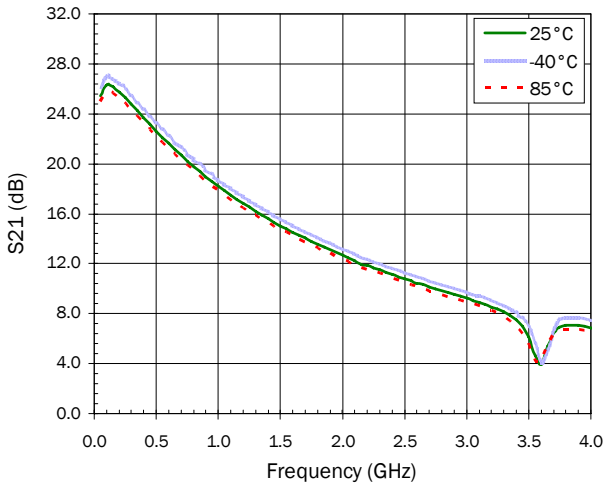


Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=90mA

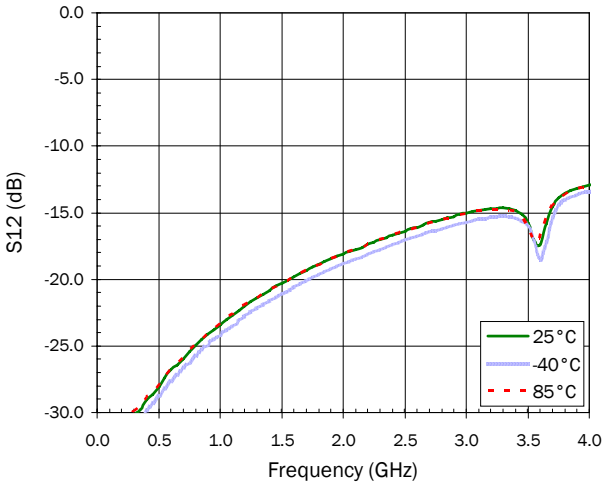
S11 versus Frequency



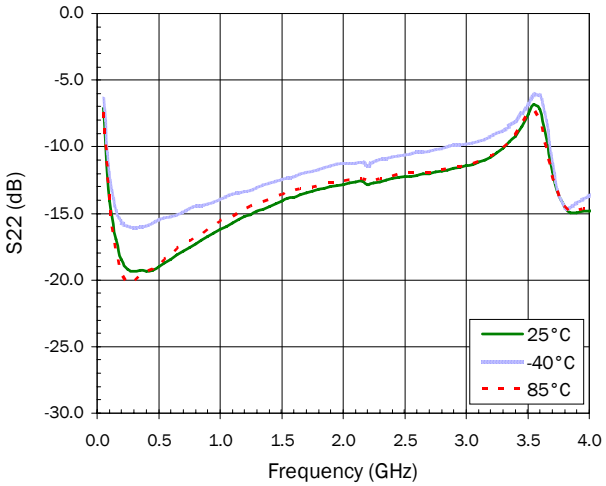
S21 versus Frequency



S12 versus Frequency



S22 versus Frequency



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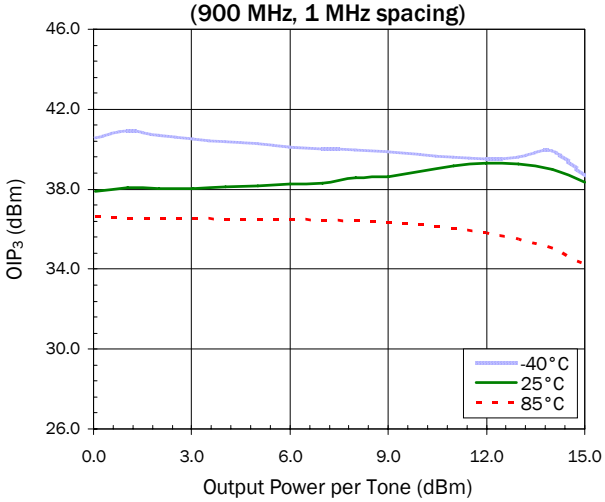
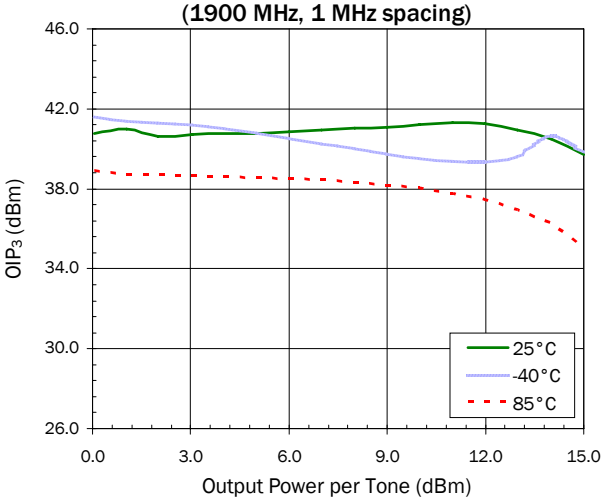
Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=90mA

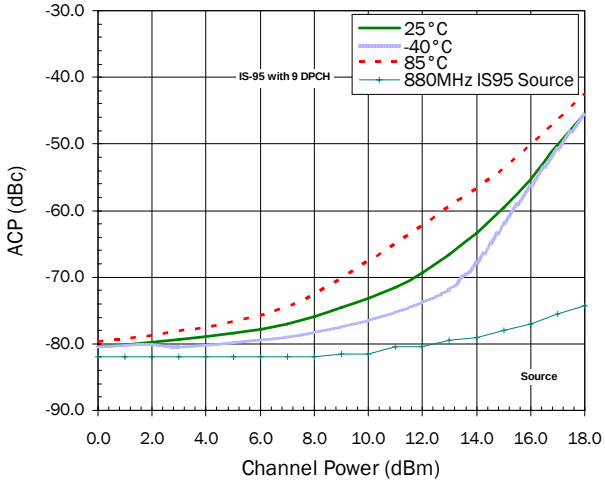
OIP_3 versus Power
(900 MHz, 1 MHz spacing)



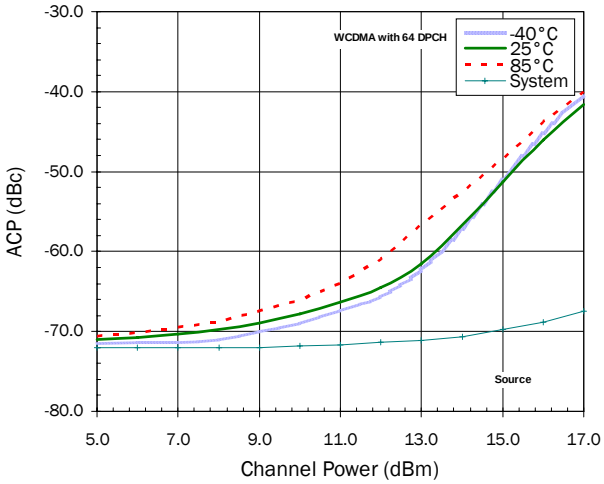
OIP_3 versus Power
(1900 MHz, 1 MHz spacing)



ACP versus Channel Power @ 880MHz

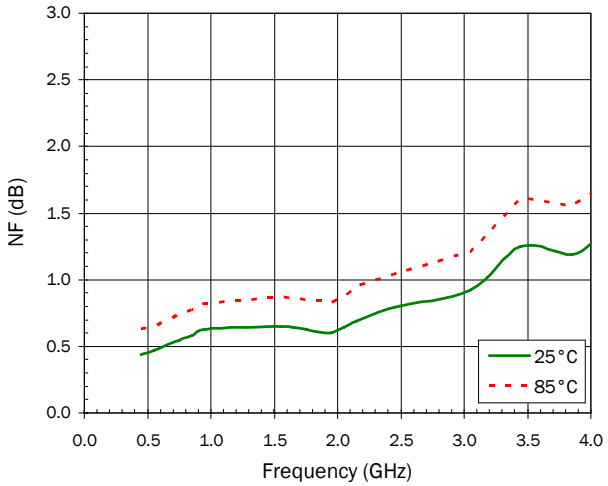


ACP versus Channel Power @ 2140MHz

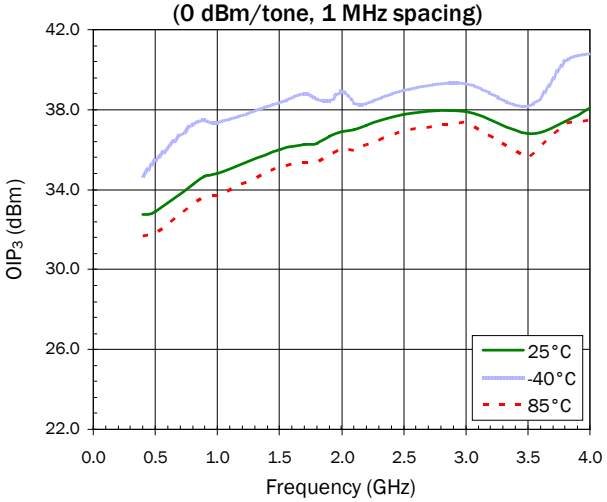


Typical RF Performance - Broadband Application Circuit with V_D=3V, I_D=58mA

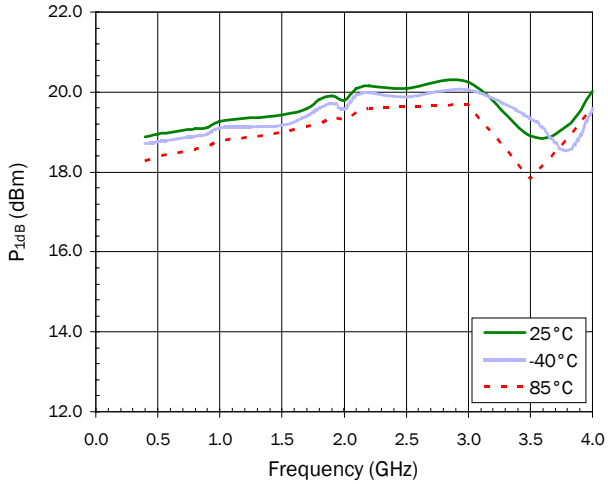
NF versus Frequency



OIP_3 versus Frequency
(0 dBm/tone, 1 MHz spacing)



P_{1dB} versus Frequency



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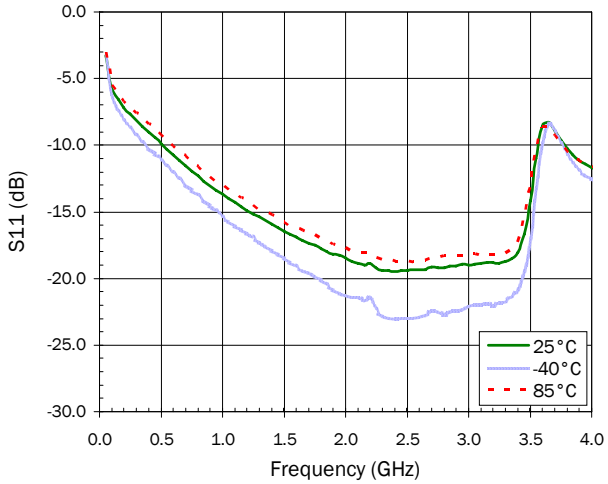
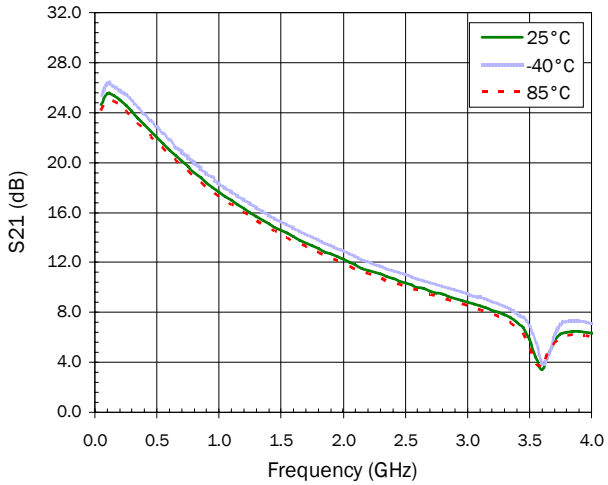
Typical RF Performance - Broadband Application Circuit with V_D=3V, I_D=58mA

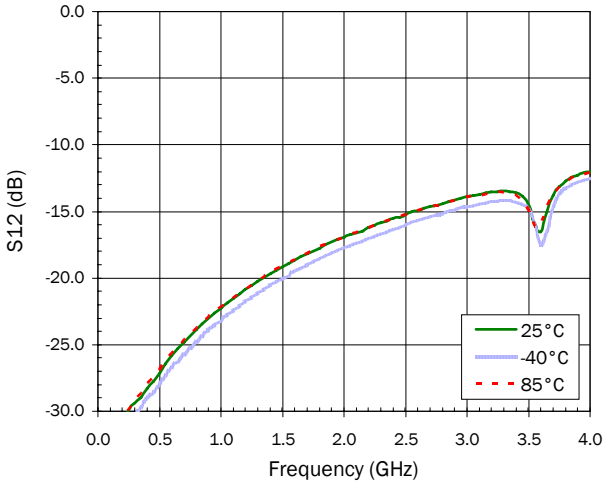
S11 versus Frequency



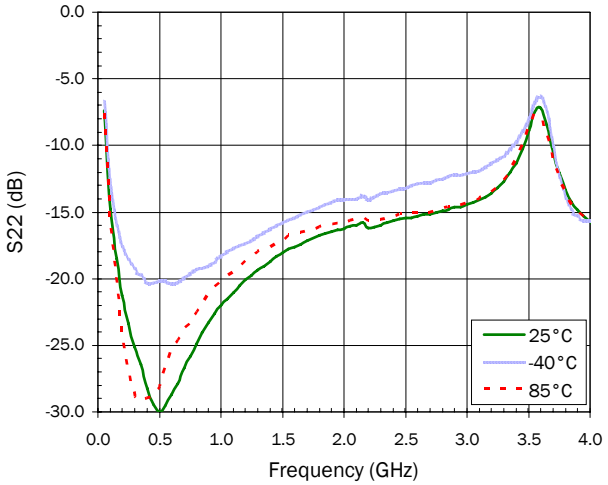
S21 versus Frequency



S12 versus Frequency



S22 versus Frequency



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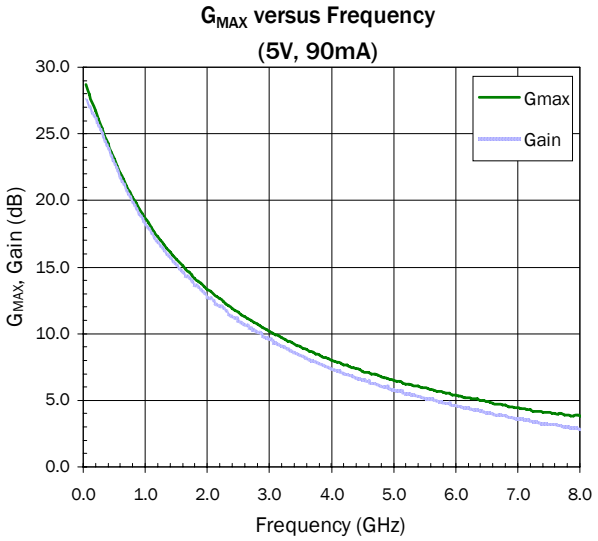
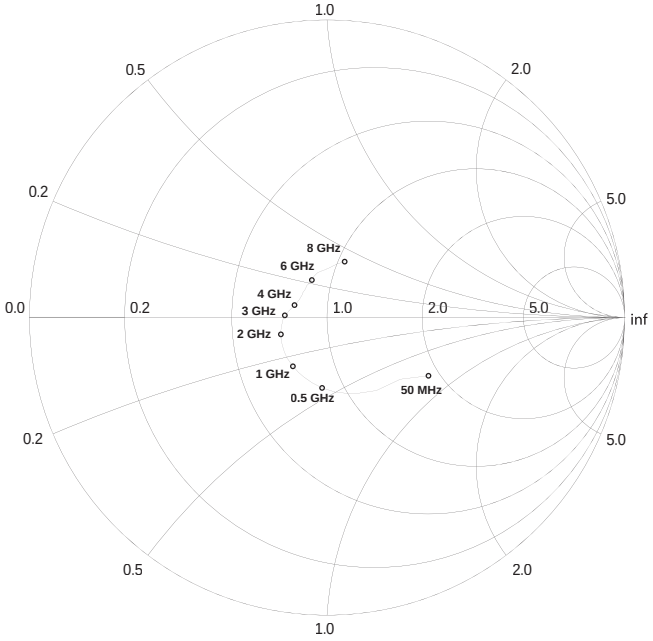
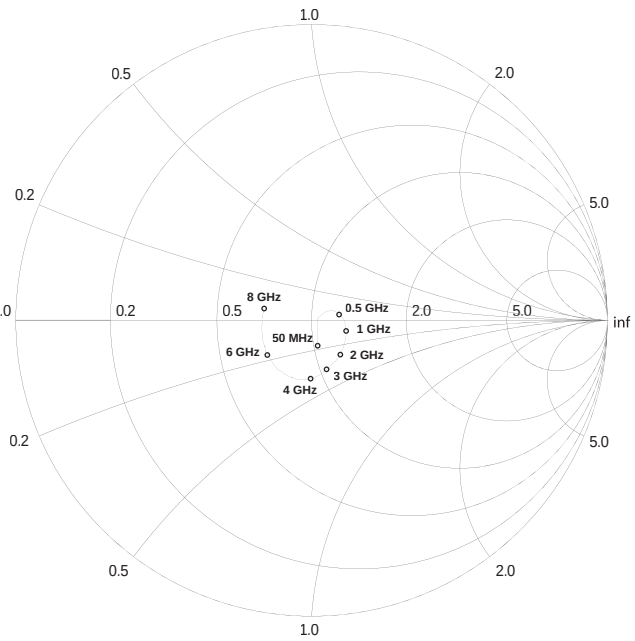
De-embedded Device S-parameters (Bias Tee Data)



S11 versus Frequency (5V 46mA)



S22 versus Frequency (5V 46mA)



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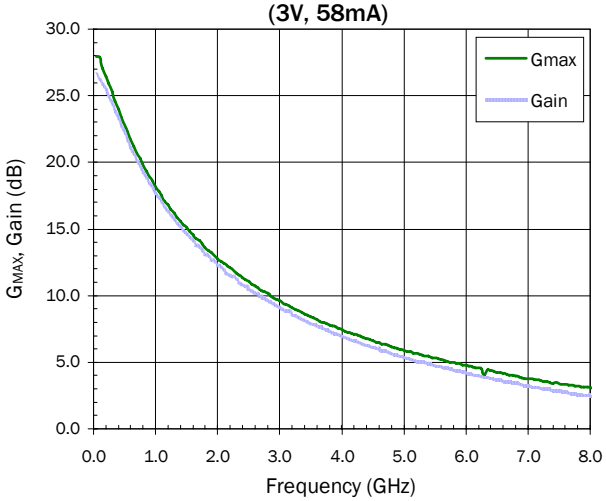
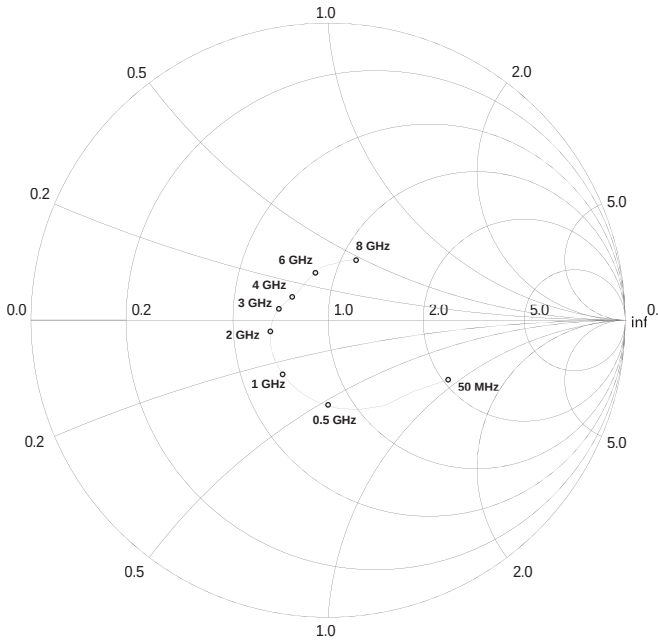
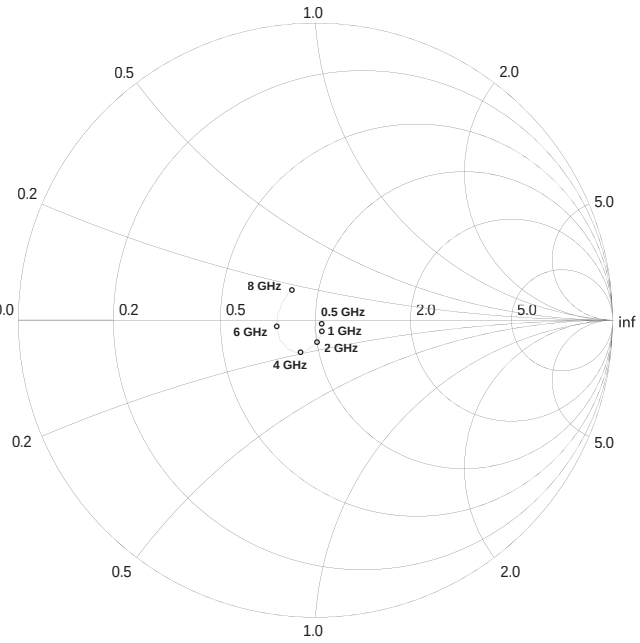
G_{MAX} versus Frequency (3V, 58mA)



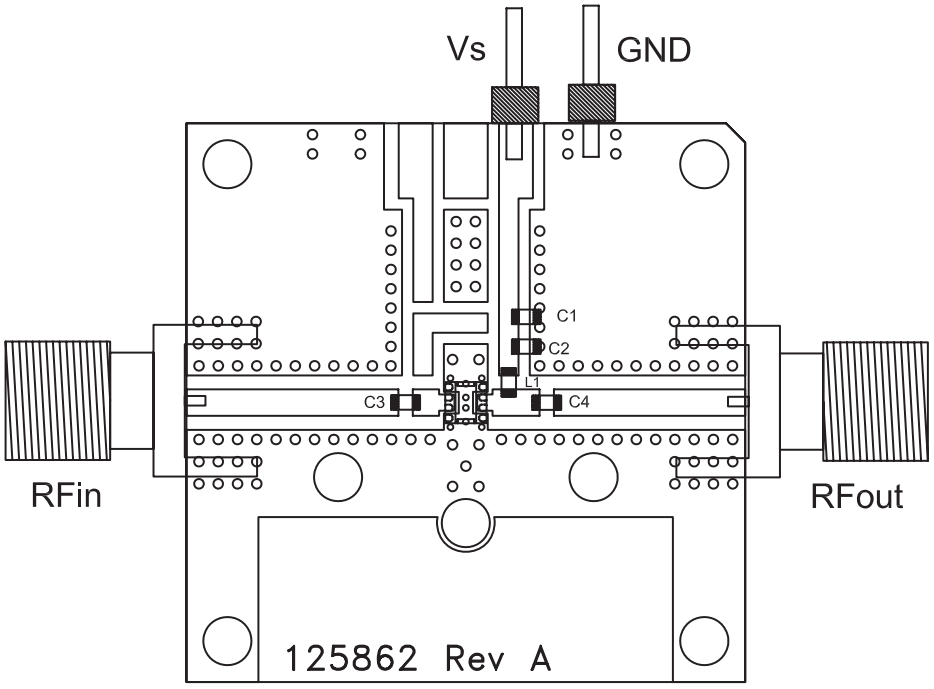
S11 versus Frequency (3V 25mA)



S22 versus Frequency (3V 25mA)



Evaluation Board Layout and Bill of Materials

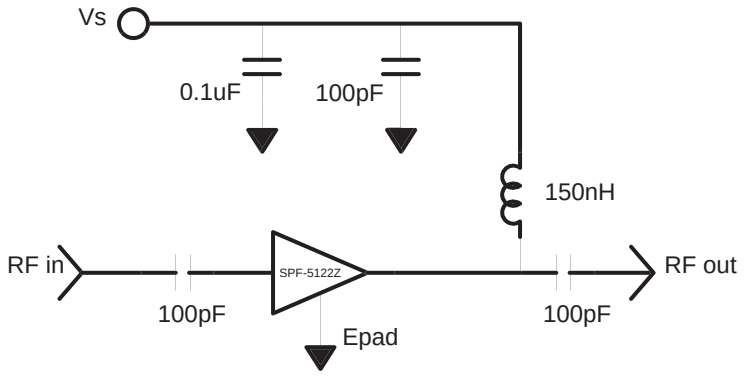


Bill of Materials (SPF-5122Z, 400MHz to 3000MHz

C1 TAJB104KLRH, Rohm, 0.1uF
C2 MCH185A101JK, Rohm, 100pF
C3 MCH185A101JK, Rohm, 100pF
C4 MCH185A101JK, Rohm, 100pF
L1 LL1608-FSR15J, Toko, 150nH
PCB 125862-A

Application Schematic

(400MHz to 3000MHz)



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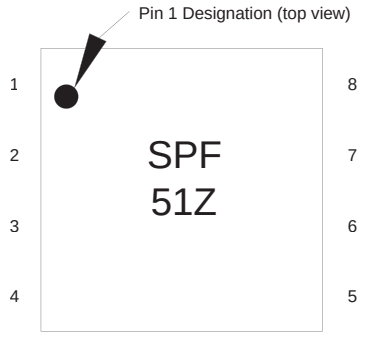
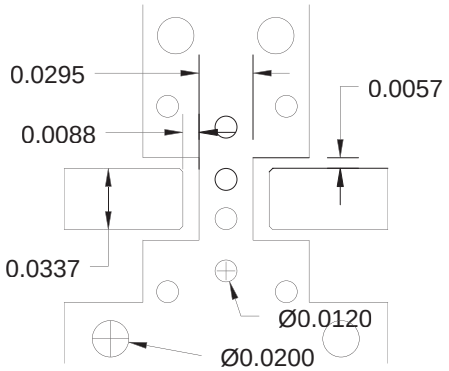
Pin	Function	Description
1,3,5, 6,8	N/A	Ground or No-Connect. No connection internal
2	RF IN	RF Input, DC coupled and matched to 50Ω. An external DC block is required.
4	N/A	Ground or No-Connect. Internally Grounded.
7	RF OUT/BIAS	RF Output, Bias applied through this pin. Matched to 50Ω.
EPAD	GND	EPAD must be conductively attached to RF and DC ground.

Part Identification

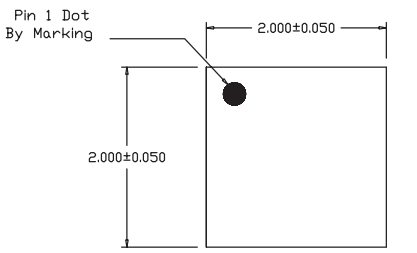


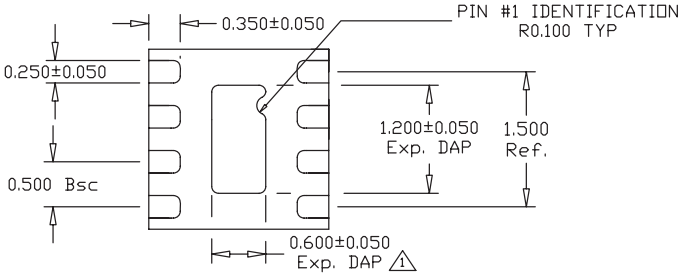
Suggested Pad Layout



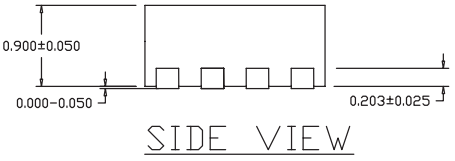
Package Drawing

Dimensions in inches (millimeters)
Refer to drawing posted at www.rfmd.com for tolerances.





Notes:
1. LF Base Metal – Olin 194
2. Exterior Platng
   Basic PN – Sn/Pb 85/15
   Z Option – 100% Matte Sn
3. Flammability Rating
   94V0
4. Marking
   Laser or White Phenolic
   Ink.



Ordering Information

Part Number	Description	Reel Size	Devices/Reel
SPF-5122Z	Lead Free, RoHS Compliant	7”	3000
SPF-5122Z-EVB1	400MHz to 3000MHz Evaluation Board	N/A	N/A

7628 Thorndike Road, Greensboro, NC 27409-9421 · For sales or technical support, contact RFMD at (+1) 336-678-5570 or sales-support@rfmd.com.